NAVIGATION.

STAGE OF WATER IN RIVERS.

In the following table are shown the danger points in the rivers at the various stations, the highest and lowest depths for November, 1884, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, November, 1884.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
	Ft. In.		Ft. In.		Ft. In.	Ft. In.
Red River:						
Shreveport, Louisiana	29 9	9 to 13	4 8	1	0 10	3 10
Arkansas:						
Little Rock, Arkansas	23 0	30	9 0	20	3 3	5 9
Fort Smith, Arkansas	15 0	28	2 0	16	‡—4 9	6 9
Missouri:						
Yankton, Dakota	24 0	1	8 2	22 to 30	6 1	2 1
Omaha, Nebraska	18 0	1 to 7	6 11	27	4 7	2 4
Leavenworth, Kansas	20 0	1 to 4	7 7	30	5 0	2 7
Mississippi:						
Saint Paul, Minnesota*	14 6	1, 2, 3	5 3	23	2 4	2 11
La Crosse, Wisconsin ‡	24 0	2, 3, 4	5 5	25	2 9	2 8
Dubuque, Iowa	16 0	1, 2, 8	8 9	30	3 5	5 4
Davenport, Iowa	15 0	1	7 2	30	3 2	4 0
Keokuk, Iowa	14 0	1	8 5	30	4 1	4 4
Saint Louis, Missouri	32 0	1	16 11	22	10 8	6 3
Cairo, Illinois	40 0	1	15 11	25	9 5	6 6
Memphis, Tennessee	34 0	1	10 7	26, 27	5 3	5 4
Vicksburg, Mississippi	41 0	4	14 1	30	5 8	8 5
New Orleans, Louisiana†	—3 0	1	—11 10	21	—13 2	1 4
Ohio:						
Pittsburg, Pennsylvania	22 0	1	3 1	20 to 25	1 0	2 0
Cincinnati, Ohio	50 0	9	6 1	1 to 5	3 0	3 1
Louisville, Kentucky	25 0	11, 12	3 11	8 9	2 9	1 2
Cumberland:						
Nashville, Tennessee	40 0	8, 9	1 5	21 22	0 5	1 0
Tennessee:						
Chattanooga, Tennessee	33 0	27 29	1 10	17	0 7	1 3
Monongahela:						
Pittsburg, Pennsylvania	29 0	1	3 0	20 to 25	1 0	2 0
Savannah:						
Augusta, Georgia	32 0	25	7 0	9	4 8	2 4
Willamette:						
Portland, Oregon	.....	6, 7	5 4	29	1 6	3 10
Sacramento:						
Red Bluff, California	.....	1 to 30	0 11	1 to 30	0 11	0 0
Sacramento, California	.....	21, 22, 23	8 0	24 to 30	7 10	0 2
Mobile:						
Mobile, Alabama	.....	1, 2	16 6	7	14 4	2 2
Colorado:						
Yuma, Arizona	.....	4	15 10	30	14 1	1 9

‡ Below bench mark. † Below high-water mark of 1874 and 1883.
* River frozen from 24th to 30th. ‡ River frozen from 27th to 30th.

At Chattanooga the lowest stage of water in the Tennessee river was attained on the 17th, when the depth was seven inches above low-water mark, or several inches lower than has been known at this season for several years; the highest stage of water was observed on the 27th and 29th, when the depth was one foot and ten inches above low-water mark.

The Cumberland river at Nashville was not navigable at any time during the month.

ICE IN RIVERS AND HARBORS.

Penobscot river.—Bangor, Maine: ice formed along the shores of the river on the 16th; during the night of the 18–19th the river froze over, but the ice was broken up by the tides during the day.

Hudson river.—Albany, New York: floating ice on the 21st.

Lake Erie.—Sandusky, Ohio: navigation for the season was practically closed on the 29th. The steamer "Jay Cooke" made her last trip to the islands on this date.

Maumee bay and river.—Toledo, Ohio: floating ice in river on the 27th, and in the bay on the 29th.

Rock river.—Rockford, Winnebago county, Illinois: river partially frozen on 24th; and on the 30th it was entirely closed.

Ontonagon river.—Ontonagon, Michigan: on the 24th teams crossed the river on the ice.

Lake Superior.—Duluth, Minnesota: during the night of the 22–23d Duluth and Superior bays froze over. The temperature fell to —17° on the 24th, when the ice was from six to seven inches thick. The barge "George Spencer" left for the lower lakes on the 25th, being the last departure of the season.

Milwaukee river.—Milwaukee, Wisconsin: the river froze over on the 25th.

Red river of the north.—Saint Vincent, Minnesota: the river froze over during the night of the 16–17th, but the ice broke up on the afternoon of the day following; the river froze over again on the 22d, closing navigation for the season.

Devil's Lake.—Fort Totten, Dakota: Fort Totten bay was covered with thin ice on the 2d; the lake froze over on the 17th, closing navigation for the season; on the 19th, the high northwesterly winds broke up the ice in the body of the lake, and heaped it along the shores, in some places, to depths of several feet.

Mississippi river.—Saint Paul, Minnesota: the last steamer of the season to leave this port, departed for Saint Louis on the 12th; floating ice in river, and the first permanent ice formed along the shores, on the 20th; floating ice continued on the 21st, 22d, and 23d; at 11 a. m. on the 24th, an ice dam formed, and by noon, the river was covered with ice as far as could be observed.

La Crosse, Wisconsin: floating ice from 23d to 26th; river froze over on the 27th; persons crossed the river on the ice on 28th; the last boat of the season left on the 23d.

Dubuque, Iowa: floating ice in river from 24th to 30th; all boats were laid up for the winter and navigation closed for the season on the 21st.

Davenport, Iowa: floating ice in river from 25th to 30th; the steamer "Wes Rambo" passed northward on the 22d, being the last boat of the season.

Muscatine, Muscatine county, Iowa: the first floating ice in river was observed on 25th.

Keokuk, Iowa: light floating ice in river on 28th and 30th; navigation was closed for the season on the latter date.

Missouri river.—Fort Yates, Dakota: floating ice in river on the 4th, 5th, 6th, 18th, 19th, 21st, 22d; the river froze over during the night of the 22–23d.

Fort Sully, Dakota: floating ice on the 5th and 6th; the river froze over during the night of the 17–18th; the high winds on the 19th broke up the ice; river froze again on the 20th; ice moved out of river on the 24th.

Fort Bennett, Dakota: floating ice on the 21st.

Maquoketa river.—Monticello, Jones county, Iowa: river froze over on the 24th.

MISCELLANEOUS.

Fort Bridger, Wyoming: considerable "anchor ice" was observed in Black's Fork of Green river on the morning of the 9th.

Edgington, Rock Island county, Illinois: at the close of the month the ground was frozen to a depth of six inches.

HIGH TIDES.

Eastport, Maine, 4th, 5th, 6th, 8th, 9th.
Narragansett Pier, Rhode Island, 19th.
New River Inlet, North Carolina, 5th, 9th, 10th.

LOW TIDES.

Eastport, Maine, 26th.
New River Inlet, North Carolina, 24th to 29th.

VERIFICATIONS.

INDICATIONS.

The detailed comparison of the tri-daily indications for November, 1884, with the telegraphic reports for the succeeding twenty-four hours, shows the general average percentage of verifications to be 85.74 per cent. The percentages for the four elements are: Weather, 90.06; direction of the wind, 82.32; temperature, 82.82; barometer, 88.58 per cent. By geographical districts, they are: For New England, 86.90; middle Atlantic states, 86.53; south Atlantic states, 86.30; eastern Gulf states, 84.87; western Gulf states, 87.00; lower lake region, 85.53; upper lake region, 86.15; Ohio valley and Tennessee, 88.30; upper Mississippi valley, 84.97; Missouri valley, 79.66; north Pacific coast region, 81.25; middle Pacific coast region, 90.83; south Pacific coast region, 91.67. There were eleven omissions to predict out of 3,252, or 0.34 per cent. Of the 3,241 predictions that have been made, seventy-six, or 2.34

per cent., are considered to have entirely failed; one hundred and eight, or 3.33 per cent., were one-fourth verified; three hundred and seventy-one, or 11.45 per cent., were one-half verified; four hundred and eighty-three, or 14.90 per cent., were three-fourths verified; 2,203, or 67.97 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

CAUTIONARY SIGNALS.

During November, 1884, two hundred cautionary signals were ordered. Of these, one hundred and eighty-two, or 91.00 per cent., were justified by winds of twenty-five miles or more per hour at or within one hundred miles of the station. Ninety-one cautionary off-shore signals were ordered, of which number seventy-eight, or 85.71 per cent., were fully justified, both as to direction and velocity; eight-nine, or 97.80 per cent., were justified as to direction; and eighty, or 87.91 per cent., were justified as to velocity. Two hundred and ninety-one signals of all kinds were ordered, two hundred and sixty, or 89.35 per cent., being fully justified. These do not include signals ordered at display stations where the velocity of the wind is only estimated. Of the ninety-one cautionary off-shore signals ordered, fifty-three were changed from cautionary. Two signals were ordered late. In sixty-nine cases winds of twenty-five miles or more per hour were reported, for which no signals were ordered.

COLD-WAVE SIGNALS.

The following circular, issued by the Chief Signal Officer, and sent to observers, postmasters, and others co-operating with the Signal Service, explains the system now in use of announcing the approach of cold waves:

SIGNAL OFFICE, WAR DEPARTMENT,

Washington City, ..., 188...

CIRCULAR.

Published by co-operation of the War and Post Office Departments.

....

....

....

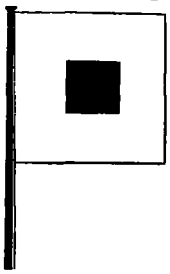
SIR: The Chief Signal Officer is desirous of increasing the usefulness of the Signal Service reports in your section. The information collected by the Signal Service, by means of the daily telegraphic reports, renders it possible for this office to announce the approach of sudden changes in temperature.

There is scarcely an industry which would not be greatly benefited by warning of the approach of *cold waves*, and especially is this true of those interested in agriculture and stock-farming.

Not possessing the necessary funds to convey this information by telegraph to the various sections of the country, the next best means has been adopted, viz., to publish the information in the Farmers' Bulletin, as follows:

"COLD WAVE COMING."

Cold-wave flag has been ordered up at....., and the temperature will probably fall.....in the next.....hours.



The country has been divided into districts, and *cold-wave* stations established at central points; when cold weather is anticipated, the *cold-wave* flag (white flag, six or eight feet square, with black centre, about two feet square) will be ordered up at the central station and the information published in the Farmers' Bulletin. These bulletins are displayed at post-offices, and it is believed that a much wider distribution of the information thus given may be secured by the display of *cold-wave* flags at the various post-offices where the bulletin may be received.

The Signal Service is not prepared to furnish these flags for general use, but arrangements have been made with two firms, who offer to furnish these flags for a small sum, viz.:

M. G. COPELAND & CO.,

643 LOUISIANA AVENUE, WASHINGTON, D. C.

6 x 6 feet white flag, with 2 x 2 feet black square in centre, made from cotton $0.65

6 x 6 feet white flag, with 2 x 2 feet black square in centre, made from best bunting, with rope in heading and toggle..... ..... $2.50

HORSTMAN BROS. & CO.,

FIFTH AND CHERRY STREETS, PHILADELPHIA, PA.

6 x 6 feet white flag, with 2 x 2 feet black square in centre, made from a good quality of bunting, with rope in heading and toggle..... ..... $2.40 and $3.50

6 x 6 feet white flag, with 4 x 4 feet black square in centre, made from the best standard bunting, with rope in heading and toggle..... $4.00 and $5.00

Please correspond directly with either of the above firms.

There may be parties residing in the vicinity of your office willing to co-operate in this work by furnishing the flag and displaying it at some prominent point for the benefit of the public. It is believed that much benefit will result from prompt action on the part of those who may be charged with the display of these flags, and probably some arrangement may be made with the railroad companies, along whose line stations may be located, to transmit by telegraph the order for the *cold-wave* signals before the receipt of the Farmers' Bulletin.

Notice of a "cold wave" is given in the Farmers' Bulletin, which is sent daily to your post office or by telegraph over lines of railroads co-operating in this work, and the flag should be displayed at once and should be taken down at the expiration of 24 hours, unless a second warning is received.

Many railroads in the country, co-operating with this service, receive the notice of "cold waves" by telegraph, and you may be able to make arrangements by which the warning of the approach of "cold waves" will be sent to you in advance of the receipt of the Farmers' Bulletin.

This office has not the necessary funds to pay for telegraphing the warning to each of the thousands of post offices in the country, and it is, therefore, at present necessary for you to secure your notice either from the Farmers' Bulletin or from some railroad company at or near your place.

I am, very respectfully, your obedient servant,

W. B. HAZEN,
Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

During November one hundred and eight cold-wave signals were displayed, and except in two instances, viz., at Chicago and Indianapolis (for the 4–6th) all of these were justified.

The following notes from the reports of the observers indicate the value of these warnings, and the favor with which they are received by the general public:

Washington, District of Columbia: "the signal (23–25th) was ordered twenty-four hours in advance of the cold wave; favorable comments were made by the press."

Louisville, Kentucky: "Hamilton Brothers, pork dealers, started killing in anticipation of colder weather (signal 16–18th). The flag was displayed thirty hours in advance of the cold wave, and attracted considerable attention; its justication elicited favorable comment."

Logansport, Indiana: "the cold-wave signals displayed during the month were justified and were of vast benefit to our people; both the press and the general public are pleased that these warnings are given by the department."

Leavenworth, Kansas: "decided benefits were derived from the display of the cold-wave signal from the 22–24th; commission men especially were enabled to profit by it."

Toledo, Ohio: "the display of cold-wave signals during the month was of especial benefit to gardeners, fishermen, roofers, and dealers in oysters, fruit, and vegetables. The warnings were furnished to the officials of the various railroads centering here, by whom they are distributed over a wide area. As soon as arrangements are completed this information will reach more than two hundred towns in Ohio, Michigan, and Indiana."

Auburn, Alabama: "much interest is taken in the predictions; the displays are watched for impatiently in the morning, and the people govern their daily movements by them. They are remarkably accurate. The citizens of this state are very grateful to the Chief Signal Officer for this liberality."

Chattanooga, Tennessee: "the displays are noted closely by the community, and due action taken, especially by coal dealers in laying in supplies, &c.

Burlington, Iowa: "the display (22–24th) was in every way justified; the temperature fell 42° in ten hours."

Philadelphia, Pennsylvania: "the weather following the cold-wave signal displays fully justified the same; the warnings were favorably commented upon by all newspapers published in this city."

Albany, New York: "many expressions of favor concerning the cold-wave signal displays."

Baltimore, Maryland: "the information furnished during the month through the display of cold-wave signals has been deemed of great value by many oyster packers and fruit importers."

Buffalo, New York: "the warning from this display was timely and correct, and the benefits derived were general."

Milwaukee, Wisconsin: "the display (22–24th) was of great

value to the commercial interests of this city and vicinity. Copies of the order were posted on the Signal Service bulletin-boards and given to the press, and to several railroad companies, by whom they telegraphed over this state and portions of Minnesota and Iowa. Shippers of fruit saved considerable perishable property by heeding the warning."

Professor P. H. Mell, jr., director of the Alabama Weather Service, in his report for November, 1884, referring to weather forecasts by means of railway signals, reports the following:

A careful examination of the meteorological reports from all quarters of the state shows the verification of the weather predictions to be 92 per cent. and of the temperature 70 per cent.

The director is gratified to perceive that the public are greatly interested in these predictions. Several stations not on the line of the railroads desire the telegrams, and stations in Georgia on the Atlanta and West Point road have sent a request for them. The stations already equipped complain greatly if the telegrams are not received promptly; and all reports show a due appreciation of the practical benefits derived from the system, and of the liberality of the Chief Signal Officer in so generously furnishing Alabama with the full advantages of these predictions.

TEMPERATURE OF WATER.

The following table shows the highest and lowest temperatures of the water at the several stations; the monthly range of water temperature; the average depth at which the observations were made; and the mean temperature of the air at the stations:

Temperature of water for November, 1884.

Station.	Temperature at bottom.		Range.	Average depth, feet and inches.		Mean temperature of the air at station.
	Max.	Min.				
	°	°	°	ft.	in.	°
Atlantic City, New Jersey	56.9	46.9	10.0	2	4	45.4
Alpena, Michigan	38.8	30.5	8.3	11	9	31.7
Augusta, Georgia	67.0	49.8	17.2	5	2	54.8
Baltimore, Maryland	58.3	46.4	11.9	10	1	46.4
Block Island, Rhode Island	52.4	44.2	8.2	6	9	45.0
Boston, Massachusetts	48.3	31.0	17.3	21	10	41.1
Buffalo, New York	51.8	37.5	14.3	10	7	37.9
Canby, Fort, Washington Territory	52.3	48.0	4.3	17	11	50.9
Cedar Keys, Florida	71.3	60.2	11.1	9	7	63.7
Charleston, South Carolina	68.8	58.6	10.2	40	4	59.1
Chicago, Illinois	48.3	33.8	14.5	7	3	39.6
Chincoteague, Virginia	61.9	44.3	17.6	3	11	49.0
Cleveland, Ohio*	52.4	39.4	13.0	14	0	38.8
Detroit, Michigan	47.2	33.6	13.6	23	9	39.6
Delaware Breakwater, Delaware	69.2	47.2	22.0	8	8	48.0
Duluth, Minnesota	42.5	35.3	7.2	9	11	29.1
Eastport, Maine	47.4	43.1	4.3	15	11	36.4
Escanaba, Michigan	46.8	35.0	11.8	17	5	30.3
Galveston, Texas	68.0	56.1	11.9	12	4	61.9
Grand Haven, Michigan	45.6	32.4	13.2	19	0	38.3
Indianola, Texas	72.5	57.5	15.0	8	4	62.7
Jacksonville, Florida	70.7	64.2	6.5	18	0	61.7
Key West, Florida	79.0	75.4	4.2	17	2	74.9
Mackinaw City, Michigan	45.9	35.1	10.8	10	0	34.3
Macon, Fort, North Carolina	67.8	55.5	12.3	6	4	55.8
Marquette, Michigan	42.8	37.0	5.8	10	0	31.3
Milwaukee, Wisconsin	48.4	33.4	15.0	8	0	35.0
Mobile, Alabama	69.8	57.7	12.1	15	7	55.5
New Haven, Connecticut	51.3	41.4	9.9	15	11	40.9
New London, Connecticut	53.8	46.2	7.6	11	6	42.9
New York City	53.0	43.5	9.5	15	10	43.2
Norfolk, Virginia	59.4	51.4	8.0	17	0	52.6
Pensacola, Florida	71.9	59.3	12.6	17	3	57.6
Portland, Maine	47.4	38.9	8.5	16	4	39.1
Portland, Oregon	50.2	44.7	5.5	52	6	46.7
Sandusky, Ohio	58.0	33.9	24.1	12	0	40.0
Sandy Hook, New Jersey	55.3	43.1	12.2	1	6	44.5
San Francisco, California	57.5	55.3	2.2	31	10	56.5
Savannah, Georgia	68.7	56.6	12.1	10	5	58.7
Smithville, North Carolina	67.3	58.0	9.3	10	8	55.5
Toledo, Ohio	47.5	32.4	15.1	10	8	40.0
Wilmington, North Carolina	67.0	56.0	11.0	18	4	57.1

* Record for twenty-eight days.

ATMOSPHERIC ELECTRICITY.

AURORAS.

But few auroral displays, none of which were noted for brilliancy or extent of observation, occurred during November. On the evening of the 2d, a display occurred which was observed at Fort Bennett, Dakota; Winnipeg, Manitoba; Ann Arbor, Michigan; Toronto, Ontario; Mountainville, New York, and at numerous stations in New England. The following reports relate to this display.

Fort Bennett, Dakota, 2d: a faint auroral display was observed in the northwestern sky at 7.20 p. m.

Ann Arbor, Michigan, 2d: auroral light visible from 6 to 8 p. m.

Toronto, Ontario: auroral light was observed on the 2d, viz: from 8.30 to 8.15 p. m., fine display of streamers and patches of aurora; 9.30 p. m. fine curtain moving west. (Canadian Weather Review.)

Providence, Rhode Island, 2d: auroral beams were seen at 9 p m., during bright moonlight; no arch was discernible.

Mountainville, New York, 2d: "aurora streaming up from west to east during the evening."

Point Judith, Rhode Island, 2d: an auroral display began at 6.42 p. m., at first consisting of streamers of yellow, blue, and green, having a waving motion. At 7.08 p. m. the streamers disappeared, leaving a diffused light which remained until 10.05 p. m., when a narrow arch appeared for about five minutes; between 10.12 and 10.25 p. m. beams of bright yellow were observed; at midnight only a faint light remained.

Thatcher's Island, Massachusetts, 2d: traces of an aurora were observed from 6.30 to 9.30 p. m.

Eastport, Maine, 2d: a brilliant auroral arch of about 25° altitude was observed from 6 to 7 p. m.

Cornish, Maine, 2d: auroral streamers were visible at 5.30 p. m.

Block Island, Rhode Island, 2d: a brilliant auroral arch, extending from northwest to northeast and to an altitude of 10°, was observed at 6.45 p. m.; beams of bright blue, changing to light green, shot up from the arch to an altitude of 30°.

Cambridge, Massachusetts, 2d: fine auroral streamers were observed at 6.30 p. m.

Portland, Maine, 2d: a few auroral streamers were observed from 9.15 to 9.45 p. m., at the latter hour clouds obscured the display.

Gardiner, Maine, 2d: a brilliant aurora appeared at 6.15 p. m.; at 6.30 two arches were visible with beams shooting upward; at 7 p. m. the arches had disappeared but a bright light was still visible, although the full moon shone brightly; at 7.15 the aurora had disappeared.

Auroral displays occurred on other dates as follows:

Omaha, Nebraska: the operators of the Western Union telegraph company report that during the night of the 1–2d, the telegraph wires were sensibly affected; the disturbance was supposed to have been due to the influence of an aurora.

Woodstock, Vermont: an aurora is reported to have been observed on the 8th.

Fort Totten, Dakota: a faint auroral light was observed in the north from 6.30 to 10 p. m. on the 9th.

Cambridge, Massachusetts, 9th: a low auroral arch was visible at 8.15 p. m.; at 11 p. m. it had disappeared.

Gardiner, Maine, 9th: faint auroral beams were observed at 6.45 p. m.; the display disappeared soon after 9 p. m.

An auroral display was also observed at Cornish, Maine, on the evening of the 9th.

Fort Totten, Dakota: light traces of an aurora were observed at 9 p. m. on the 10th.

North Colebrook, Connecticut: an aurora was observed at 11.50 p. m. on the 11th.

At Winnipeg, Manitoba, auroral displays were observed on the evenings of the 13th and 14th.

Moorhead, Minnesota, 17th: a faint aurora was visible from 8.45 to 10.15 p. m., consisting of a pale glow reaching from north to northeast, and to an altitude of 35°; a few slender streamers were observed from 8.45 to 9.10 p. m.

At Fort Totten, Dakota, an auroral arch was observed in the north from 8.30 to 11.20 p. m. on the 17th; and at Cambridge, Massachusetts, at 11 p. m. on the same date, a low auroral arch was visible.

Manistique, Michigan: a diffuse auroral light was visible in the north on the evening of the 17th, from 8 p. m. until midnight.

Gardiner, Maine, 18th: bright aurora at 8 p. m.; at 9 p. m., it had disappeared.